AIR RESOURCES BOARD
EQUIPMENT AND PROCESS PRECERTIFICATION EVALUATION
(CONVERSION OF PROVISIONAL EQUIPMENT PRECERTIFICATION)
July 1, 1998

Applicant: **Fulton Boiler Works, Incorporated**
3981 Port Street, Box 257
Pulaski, New York 13142-0257

Application No.: 95004
Executive Order: G-70-174-A

Model Numbers: **ICS 30-LE; ICW 30-LE; ICX 30-LE; FB-030-A-LE; and FB-30-F-LE**

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GENERAL INFORMATION:

1. Program Background and Applicant Request

The Air Resources Board's (ARB's) Equipment and Process Precertification Program (Program) is a voluntary statewide program for manufacturers of commonly-used equipment that emit air pollutants. This Program is designed to assist local air pollution control and air quality management districts (Districts) in their efforts to streamline the air pollution permit process. On June 14, 1996, the Air Resources Board (ARB) adopted section 91400 of the California Code of Regulations which incorporates the Criteria for Equipment and Process Precertification (Criteria). The regulation and Criteria were approved by the California Office of Administrative Law on October 31, 1996 and became effective on November 30, 1996. Prior to the regulatory approval, the ARB staff conducted a pilot precertification program. All equipment provisionally precertified under the pilot program was given the option to convert the provisional precertification upon the payment of fees.

This evaluation is designed to verify performance claims made by manufacturers with regard to specific equipment models. Performance claims are made by the applicants in the Scope of the Precertification as part of the application package. All manufacturer claims must be supported through verification testing and validated by ARB staff review.

Fulton Boiler Works, Incorporated (Fulton) requested conversion of the provisional precertification issued under the ARB Equipment and Process Precertification Pilot Program for the **Fulton 30 horsepower** natural gas steam boiler (model numbers **ICS 30-LE; ICW 30-LE; ICX 30-LE; FB-030-A-LE; and FB-30-F-LE**.)

2. Equipment / Process Description:

Type of Equipment:	gas fired steam boiler
Description Process:	high and low pressure process steam and hot water boilers
Fuel:	PUC quality natural gas
Boiler Heat Output:	**30 horsepower (BHP)**
Model Numbers:	**ICS 30-LE; ICW 30-LE; ICX 30-LE; FB-030-A-LE; and FB-30-F-LE**
Heat Input:	**1,260,000 British thermal units per hour (BTU/hr)**

3. Air Pollution Control Equipment:

The **Fulton 30 BHP** steam boiler (model numbers **ICS 30-LE; ICW 30-LE; ICX 30-LE; FB-030-A-LE; and FB-30-F-LE**) consists of a burner that utilizes a premix design which combines fuel and air prior to the ignition point. The premix gas then flows at an increased velocity which decreases the residence time of reactants within the flame zone, which reduces the emissions.

SUMMARY OF THE SCOPE:

The applicant has identified three standards which they are seeking precertifications for the **Fulton 30 BHP** steam boiler (model numbers **ICS 30-LE; ICW 30-LE; ICX 30-LE; FB-030-A-LE; and FB-30-F-LE**). These standards are:

1. Oxides of nitrogen (NO_x) less than 25 parts per million by volume measured on a dry basis (ppmvd), corrected to 3 percent oxygen (O_2)
2. NO_x less than 20 nanograms per Joule (ng/J), or less than .05 pounds per million British thermal units (lb/MM BTU)
3. Thermal Efficiency of greater than 75 percent

APPLICABLE STATE AND FEDERAL REQUIREMENTS:

There are no applicable State and federal air pollution regulations for boilers of this size. According to the CARB California Clean Air Act Guidance RACT/ BARCT Determination for Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters (July 18, 1991), the emission limit is 30 ppm of NO_x on gas firing of all industrial, institutional, and commercial boilers, steam generators and process heaters for rated heat input greater than or equal to 149 hp (5 MM BTU/ hr).

EMISSIONS:

The emission estimate for NO_x is based on using the precertification concentration values of 25 ppmvd of NO_x as a limit. This assumes that all NO_x formed is in the form of NO_2. NO_x is

the only pollutant validated for this precertification under the ARB Equipment and Process Precertification Program.

Pollutant	Emission Factor	Potential to Emit
NO_x	30.22 lb/MM cf	**3.81 E-2** lb NO_x/hr

Emissions for the other criteria pollutants has been estimated using the United States Environmental Protection Agency (U.S. EPA) AP-42 Section 1.4 for Commercial Boilers (.3-<10 MM BTU) Controlled- Low NOx Burner (Revised January 1995) and the maximum heat input of the unit, **1,260,000 BTU/hr**. These emissions have not been verified by emissions testing, but are provided for informational purposes for the Districts.

Pollutant	Emission Factor	Potential to Emit
CO	21 lb/MM cf	**2.65 E-02 lb/hr**
SO_2	.6 lb/MM cf	**7.56 E-04 lb/hr**
VOC	5.28 lb/MM cf	**6.65 E-03 lb/hr**
PM	12 lb/MM cf	**1.51 E-02 lb/hr**

Emissions of formaldehyde has been estimated using U.S. EPA- 450 / 2-90-011, Toxic Air Pollutant Emission Factors - A Compilation for Selected Air Toxic Compounds and Sources, Second Edition (October 1990) for commercial natural gas combustion. These emissions have not been verified by emissions testing, but are provided for informational purposes for the Districts.

Pollutant	Emission Factor	Potential to Emit
HCHO	.2203 lb/MM cf	**2.78 E-04 lb/hr**

EVALUATION OF TEST REPORT:

Testing was conducted by an independent testing laboratory, the Center for Emissions Research and Analysis (CE-CERT) located in California. The testing protocol was followed in accordance with South Coast Air Quality Management District (SCAQMD) Rule 1121 Nitrogen Oxides Emissions Compliance Testing for Natural Gas-Fired Water Boilers (September 16, 1992) using SCAQMD Method 100.1. Currently, the SCAQMD method is more stringent than ARB method 100. The SCAQMD method specifies certain performance requirements that discriminates against faulty data. The SCAQMD method also includes procedures which assist to

better ensure there are no leaks in the system. Recently, the ARB method 100 was revised to align more closely with the SCAQMD method.

The test report evaluation was conducted by ARB Monitoring and Laboratory Division. It was their recommendation along with the staff of the Stationary Source Division, Project Support Section that the **30 BHP** steam boiler (model numbers **ICS 30-LE; ICW 30-LE; ICX 30-LE; FB-030-A-LE; and FB-30-F-LE**) can be precertified meeting the standard of less than 25 ppmvd of NO_x corrected to 3 percent oxygen. The Fulton boiler has been adjusted by the manufacturer and the air-fuel ratio is fixed for each boiler. The **30 BHP** steam boiler (model numbers **ICS 30-LE; ICW 30-LE; ICX 30-LE; FB-030-A-LE; and FB-30-F-LE**) can be precertified meeting the NO_x standard of being less than .05 lb/MM BTU (20 ng/J). Additionally, the steam boiler can be precertified meeting the thermal efficiency of greater than 75 percent.

The steam boiler that was tested has the same configuration as the models for which Fulton is seeking certification. This unit was tested with the high velocity/ excess air premix low NO_x burner installed. Verification that the boilers tested were equipped with the low-emission burners described above was supplied by both a letter from CE-CERT and Fulton.

CONCLUSIONS:

The test data, scope, and application were submitted by Fulton for precertification consideration. The test data was reviewed by the Monitoring Laboratory Division of the ARB, and found to meet the data quality objectives outlined in the scope for NO_x and the thermal efficiency. The ARB has reviewed this information along with applicable State and federal air pollution rules and have concluded that this boiler is generally exempt from current State and federal rules. However, local air district rules may be applicable in some regions. The applicable air districts were forwarded a copy of the precertification evaluation for review and comments.

RECOMMENDATIONS:

The Center for Emissions Research and Analysis test data was found to support the standards identified by Fulton regarding the **Fulton 30 BHP** steam boiler (model numbers **ICS 30-LE; ICW 30-LE; ICX 30-LE; FB-030-A-LE; and FB-30-F-LE**) The test data verified these standards that the boiler would meet 25 ppmvd NO_x corrected to 3 percent O_2 with a maintained thermal efficiency of greater than 75 percent. Therefore, the ARB staff recommends precertification under the Equipment Precertification Pilot Program of the **Fulton 30 BHP** steam boiler (model numbers **ICS 30-LE; ICW 30-LE; ICX 30-LE; FB-030-A-LE; and FB-30-F-LE**) to the standards stated above .

PRECERTIFICATION CONDITIONS:

1. Precertification does not relieve the person constructing, installing or operating the equipment at each specific site from the requirement to obtain all authority to construct and permit(s) to operate. Precertification does not relieve a person from compliance with any local air rule or regulation.

2. Any manufacturer's modification that affects the performance or emissions of this boiler shall void this precertification. This precertification is valid only for the equipment designed and tested for this evaluation.

RECOMMENDED OPERATING CONDITIONS:

1. This equipment shall be properly operated and maintained in accordance with manufacturer's recommended operating and maintenance instructions. This includes cleaning the burner assembly every six months and keeping the equipment in good operating conditions at all times.

2. This boiler shall be fired with PUC quality natural gas only.

APPENDIX A

CALCULATIONS

1. ESTIMATED EMISSIONS FOR PRECERTIFIED POLLUTANTS:

NO_x is the only pollutant claim requested for this precertification. The emission factor in lbs per MMBTU was determined using the threshold value of 25 ppm of NO_x corrected to 3 percent oxygen ($\%O_2$), as specified in the scope by the applicant.

This emission factor was determined using 40 CFR Method 19: Determination of Sulfur Dioxide Removal Efficiency and Particulate Matter, Sulfur Dioxide, and Nitrogen Oxides Emission Rates, Section 2.1. Using section 2.1 when both the pollutant and the concentration are measured on a dry basis the emission rate can be determined from:

$$E = C_d F_d [20.9 / (20.9 - \%O_{2d})]$$

E= emission rate
C_d= concentration in lb/dscf
F_d= F Factor for natural gas = 8710 dscf /MM BTU
O_{2d}= 3 (since concentration is corrected to 3%)

First, convert the concentration

$$C_d = C_{ppm} XM$$

C_d= concentration in lb/dscf
C_{ppm}= concentration of pollutant in ppm
X= mole fraction of NO_2
M= conversion factor of 1 lb mole of combustion gas to dscf at an absolute pressure of 14.7 psia and a temperature of 68 F.

C_d = (25 E-06) (46 lb NO_2 / 1 lb mole NO_2) (1 lb mole / 387 dscf)
C_d = 2.97 E-6 lb/dscf

Then substituting values into the emission rate equation:

E= (2.97 E-6 lb/dscf) (8710 dscf / MM BTU) (20.9 / 17.9) (1000 BTU / cf)
E= 30.2 lb NO_2 / MM cf

The NO_x emissions per hour can be determined using the maximum heat input of the unit = **1,260,000 BTU/hr** [For natural gas 1 cf = 1000 BTU]. The potential to emit was determined using:

$$PE = EH$$

PE = estimated potential to emit
E= emission factor
H= heat input

Estimated NO_x potential to emit = (30.22 lb NO_x /MMcf) (1 cf / 1000 BTU) (**1,260,000** BTU/hr)
= **3.81 E-2** lb NO_x/hr

2. ESTIMATED EMISSIONS FOR THE OTHER CRITERIA POLLUTANTS:

For the other pollutants, emissions were estimated using AP-42 Section 1.4 emission factors and the potential to emit equation above. The maximum heat input of the unit = **1,260,000 BTU/hr** [For natural gas 1 cf = 1000 BTU]. The resulting emission estimates are:

CO emission factor= 21 lb /MMcf
CO = (21 lb/MMcf) (1 cf / 1000 BTU) (**1,260,000** BTU/hr) = **2.65 E-02** lb /hr

PM(total) emission factor= PM (filterable) + PM (condensible)
= 4.5 lb/MMcf + 7.5 lb/MMcf = 12 lb /MM cf
PM = (12 lb/MMcf) (1 cf / 1000 BTU) (**1,260,000** BTU/hr) = **1.51 E-02** lb /hr

SO_x emission factor= .6 lb /MMcf
SO_x = (.6 lb/MMcf) (1 cf / 1000 BTU) (**1,260,000** BTU/hr) = **7.56 E-04** lb /hr

VOC emission factor= (1-.34)" 8.0 lb/MMcf = 5.28 lb/MMcf
VOC = (5.28 lb/MMcf) (1 cf / 1000 BTU) (**1,260,000** BTU/hr) = **6.65 E-03** lb /hr

" methane comprises 34 percent of the total organic compounds

3. ESTIMATED EMISSIONS OF FORMALDEHYDE:

For formaldehyde, emissions were estimated using U.S. EPA- 450 / 2-90-011, Toxic Air Pollutant Emission Factors--A Compilation for Selected Air Toxic Compounds and Sources, Second Edition (October 1990) for commercial natural gas combustion.

HCHO emission factor = 220.3 lb /10 E12 BTU
HCHO = (220.3 lb/ 10 E12 BTU) (**1,260,000** BTU/hr) **= 2.78 E-04** lb /hr

4. CORRECTION FROM MEASURED TEST DATA OF NO_X TO 3% OXYGEN:

Since the oxygen concentration was not measured, estimating the emissions concentrations corrected to 3% oxygen requires estimation of oxygen content from carbon dioxide based on an assumed fuel composition. It was assumed that the natural gas composition was pure methane. The combustion reaction for methane burned with air containing 21% oxygen is:

$$2\ O_2 + 2\ (.79\ /.21)\ N_2 + CH_4 \text{ - -- > } CO_2 + 2\ H_2O + 2\ (.79/.21)\ N_2$$

In dry stoichiometric combustion products the fractional CO_2 concentration is:

$$1 / (1 + 2(1-.21) /.21) = .11732 = 11.732\ \%$$

Percentage of CO_2 in the dry stack gas = P_{co2}
Fraction of the dry stack gas which is dry combustion products = P_{co2} / 11.732
Fraction of dilution air in the stack gas = (1 -P_{co2} / 11.732)
Fraction of oxygen concentration in the dry stack gas = estimated O_2 % = 21% (1 - P_{co2} / 11.732)

$$[\ NO_x]_{@\ 3\%\ O2} = [NO_x]_{@\ \text{actual}\ \%O2}\ \ (21\text{-}3)/\ (21\text{- actual}\ \%O_2\ )$$

Test	CO_2 %measured	O_2% estimated	NO_x ppmv measured	NO_x ppmv corr. to 3% O_2
1	7.875	6.904	16.897	21.577
2	7.788	7.060	16.272	21.011
3	7.751	7.126	15.922	20.657
			avg=	**21.081**

5. THERMAL EFFICIENCY:

From test data submitted from test **#FB-CS-030-A**
% Thermal Efficiency = 100 (BTU Out / BTU In)

Test	BTU In / hr	test duration (hr)	BTU In	BTU Out	% Efficiency
1	1266438	0.567	718070	545374	76.0
2	1265499	0.692	875725	679466	77.6
3	1265107	0.583	737557	567002	76.8
				avg=	76.8